

The use of ultrasound in the diagnosis of Tenckhoff catheter tunnel infection

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Abstract

Exit site infections of Tenckhoff catheters in patients on peritoneal dialysis are rather common. These very often remain localised but they may spread along the tunnel of the catheter. These infections are very important to be diagnosed quickly as untreated they usually necessitate the removal of the dialysis catheter. The use of ultrasound to aid diagnosis has been reported in various case studies. We here report the use of ultrasound to aid the diagnosis of a tunnel infection in a patient on peritoneal dialysis.

Case report

A 70 year old gentleman had a Tenckhoff catheter routinely inserted in the left lower abdominal area for eventual use for continuous ambulatory peritoneal dialysis, as the patient was in end-stage renal failure. On the seventh day post-op priming of the catheter was started at the renal unit. There was good inflow and outflow and the effluent was clear, but an exudate

from the wound was noted. This was cleaned and dressed. On a subsequent visit the exudate from the exit site of the Tenckhoff catheter had increased, the area was red and indurated, tender to touch and pus came out on pressing. The patient was given 200mg ciprofloxacin intravenously and started on flucloxacillin 500mg orally every six hours.

The following day he was seen again. The same clinical situation was present and it was decided that the patient should undergo an ultrasound of the tunnel of the Tenckhoff catheter to visualise any collection of pus along the tunnel. The ultrasound was carried out and this revealed a fluid collection measuring about 20x7 mm in the subcutaneous tissue of the abdominal wall at the entrance side of the catheter and some more fluid along the catheter tract (Figure 1A). The patient was thus admitted to a medical ward and he was started on intravenous ciprofloxacin and flucloxacillin. Over the next two days there was no improvement in the clinical picture and it was decided that the Tenckhoff catheter needed to be removed. One dose of intraperitoneal vancomycin was given before the procedure. After removal of the Tenckhoff catheter the exit site was flushed with diluted hydrogen peroxide and bethadine and covered.

Peritoneal dialysis is a form of renal replacement therapy that utilises the peritoneal lining as a semi permeable membrane for exchange, and the abdominal cavity as a chamber to house the dialysate during the process. Access to the abdominal cavity is most commonly achieved by means of a dual-cuff catheter that traverses the subcutaneous tissues of the abdominal wall obliquely and is secured by a short polyester cuff at each end. The role of the cuff is to encourage fibrosis and anchor the catheter. The catheter and exit site should be kept covered and protected from contamination and monitored regularly for evidence of infection, as sepsis can be catastrophic and may lead to catheter loss and intra-abdominal adhesions which may make further dialysis via this route painful or even impossible. Despite best efforts, sepsis will occasionally occur, and severe or persistent infection are an indication to remove the catheter until healing has occurred. Of note, Cloutier et al¹ have successfully salvaged catheters by changing the extraperitoneal portion of the apparatus.

The management of catheter-related infections is a major concern in patients on continuous ambulatory peritoneal dialysis. Early recognition and discrimination of the extent of infection are important when taking therapeutic decisions as they may prolong survival of the catheter and reduce patient morbidity.² The infections that complicate Tenckhoff catheters

Keywords

Peritoneal dialysis, ultrasound, infection

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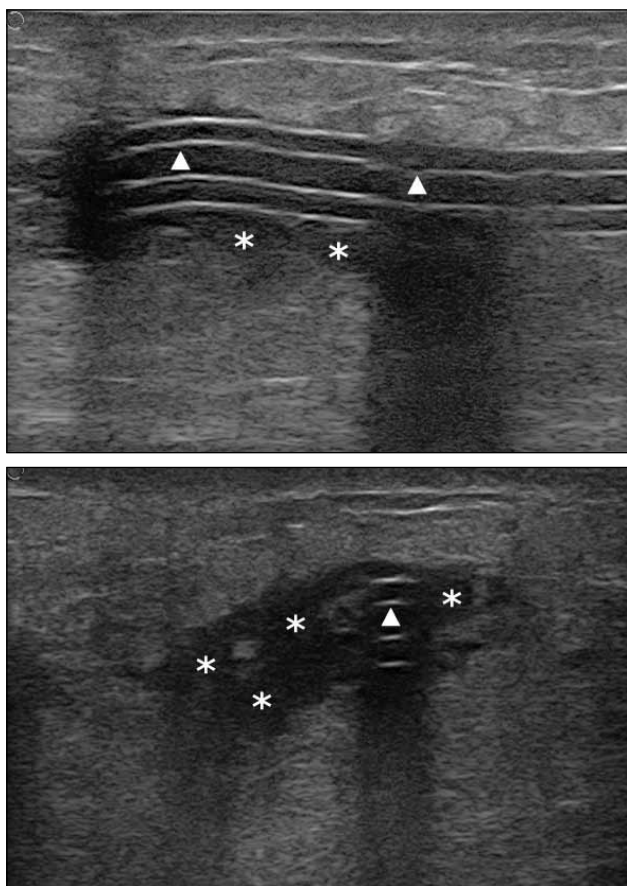
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Figures 1A & 1B: Tunnel sonography performed with a 10-14MHz linear ultrasound probe in a patient with confirmed 'tunnel' infection

Annotation: Images showing CAPD catheter (arrowhead) as seen in profile (A) and along its length (B) in a patient with tunnel infection demonstrating surrounding peri-catheteric hypo-/an-echoic fluid collection (asterix)

are divided into exit-site infections (ESI), tunnel-infections (TI) and peritonitis. Exit-site infection and peritonitis should not, by definition, involve the tunnel, but Plum *et al* found a significant rate of subclinical tunnel involvement in those they evaluated with tunnel sonography (TS)³. Korzets *et al*⁴ agree and suggest that clinical evaluation alone is "inadequate and insensitive" in excluding tunnel involvement. They found a 62% rate of TI in patients with peritonitis or exit-site infection that had defied clinical examination. This data is supported by similar data by Karahan *et al*⁵, with TI occurring in 54% of patients with peritonitis and in 75% of patients with an exit-site infection when evaluation by TS.

The early post-operative period is the time when most infections occur, but they can develop at any time, especially if there has been trauma to the exit site or excessive movement of the external, free portion. ESI are superficial infections that are normally characterised by erythema, tenderness, oedema of the skin surrounding the catheter's exit and purulent discharge. Erythema is bright pink or red in appearance and is normally more than 13 mm in diameter. There may be crusting or scabbing. Discharge may not be visible to initial inspection

and may only become apparent after it has been expressed by gentle pressure, or after inspection of the dressings. The skin may be found to have lost its typical dermatoglyphics on closer inspection. There may occasionally be systemic symptoms, such as fever. Exuberant granulation is more typical of chronic than acute infections.

Peritonitis is more straight forward and is characterised by abdominal pain, fever, bloating, a cloudy effluent and leukocytosis within the dialysate. It is more frequent for such patients to have systemic features such as anorexia and lethargy, and infection is sometimes also associated with changes in bowel habit. TI, the third category of catheter-associated sepsis, is associated with erythema, tenderness and fluctuancy along the course of the catheter, occasionally accompanied also by systemic features of sepsis.

It is important to note that there is a gradual continuum between all of these types of catheter-associated sepsis and a normal, healthy wound. It is not uncommon for an exit site to appear suboptimal when examined without satisfying criteria for diagnosing infection. In normal and healthy exit sites, a strong and mature epidermis should cover all visible parts of the sinus. Some granulation tissue or clear watery discharge is common and should not be a reason to start antibiotic therapy. Rather, it should prompt early review and re-evaluation of the health of the whole apparatus until healing is complete.

It is of vital importance to try and obtain cultures from catheter-associated infections, and treatment should be started according to sensitivities if the patient's clinical condition permits (although it is not uncommon for cultures to remain negative). Both Gram positive and Gram negative infections occur, and organisms causing different types of catheter-associated infection tend to differ subtly. The choice of antibiotic therapy, the use of adjuvant exit-site care, the route of treatment and the duration are particularly dependent on the extent and location of infection. ESI may be amenable to topical therapy, although this is usually only used to supplement systemic therapy. Plum *et al* suggest that TI are better treated with intraperitoneal antibiotics than with oral². Equivocal ESIs may be treated with close observation and meticulous catheter care, supplemented by laboratory investigations if any discharge is observed.

Korzets *et al*⁴ evaluated the role of tunnel sonography in the assessment of tunnel infection in their study. They used a cut-off of 2mm in the width of sonographic hypoechogenicity, mainly due to the resolution of the scanner they used. Plum *et al*³, in a similar study, found an association between the suspicion of tunnel infection on US and the risk of peritonitis. The presence of pericatheter fluid was found to be consistent with surgical findings, and with histopathologic changes in those referred for surgery. In their 1999 paper, Vychytil *et al*⁶ suggest that tunnel sonography is indicated in the following situations: in the evaluation of patients with evidence of catheter-associated infection (including ESI, TI or peritonitis), for follow-up of confirmed TI and for estimating prognosis in such infections. They recommend against the use of ultrasound

as a routine screening tool or as part of the investigation of pyrexia of unknown origin, unless symptoms suggest a catheter-associated infection. Pain in isolation was not recommended as an indication for tunnel sonography.

Huang et al and Barnacle *et al*⁷ also mention the usefulness of ultrasound in the evaluation of cuff-retention. The current guidance by catheter manufacturers is that all catheter cuffs should be removed if possible. Although uncommon, sequelae of retained cuffs have been documented, and include sepsis, delayed healing and abnormal appearances on ultrasonographic studies. Cuffs left in situ have sometimes been mistaken for metastatic nodules, leading to inappropriate cancer staging and, consequently, inappropriate choices of treatment.

Ultrasound is a useful and non-invasive way to assess Tenckhoff catheters when sepsis is suspected. This evidence suggests that it is essential for the expeditious treatment of patients, and to help avoid unnecessary over treatment. The use of ultrasound is also helpful in detecting infections in other tunnelled lines such as central venous catheters, Hickmann lines, VP shunts and permanent catheters.

The role of ultrasonography is to confirm the clinical suspicion of an infection at the site of insertion of the CAPD catheter. Tunnel sonography plays an essential part in the early diagnosis of tunnel involvement in patients with exit site infection (including cases with simultaneous peritonitis), for assessment of response to therapy in confirmed exit site and tunnel infections, and in CAPD patients with recurrent peritonitis.⁶ Tunnel sonography is not indicated for routine screening, searching for foci of infection, in cases of peritonitis without exit-site infection, or in patients with pain in the course of the catheter tunnel showing no other clinical signs of exit-site infection.

The clinical indication, together with any other background information of relevance, should be communicated to the radiologist performing this investigation. As in any other clinical procedure, informed consent is of vital importance. The patient should be made aware that ultrasonography is a minimal risk procedure and that on the other hand the findings may not be necessarily diagnostic. The procedure itself together with the information obtained following the study should be explained to the patient.

A linear probe is used since this gives a better view of the superficial structures when compared to a curved probe. The frequency of the transducer determines the depth of sound penetration and the resolution of the image. In general, transducers of higher ultrasound frequencies provide high resolutions but lose their signal strength quickly, and therefore provide poor penetration of deeper tissues.

Sonographic indicators of a tunnel infection include subcutaneous peri-catheteric fluid collection/s and peri-catheteric hyperaemia on colour Doppler (Figure 1 and 2). Fluid collections appear as a low-reflective cuff of fluid surrounding the catheter. Peri-catheteric hyperaemia is assessed by using Doppler. Measurement of the width of the peri-catheter fluid

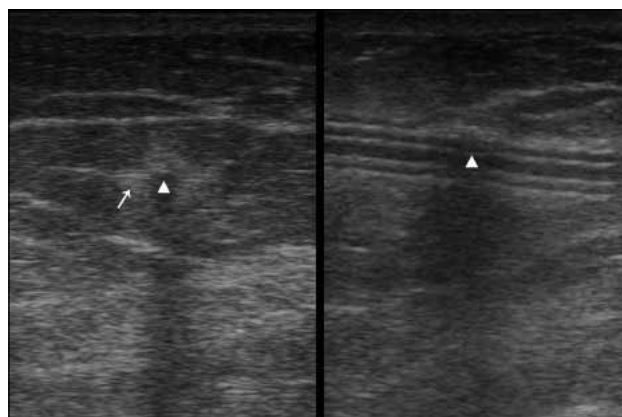


Figure 2: Tunnel sonography in a patient with no sonographic evidence of exit-site or tunnel infection

Annotation: CAPD catheter (arrowhead) as seen in profile and along its length. The surrounding ill-defined hyperechoic regions (arrow) are secondary to the sclerotic local chronic inflammatory response propagated by the peritoneal dialysis catheter

may also allow predication of which patients are responding to treatment, thereby potentially identifying those which would eventually require removal of the CAPD catheter.⁸ A sonolucent zone around the external cuff >1 mm thick following a course of antibiotic treatment and the involvement of the proximal cuff are associated with poor clinical outcome.⁹

Many tunnel infections are occult and detected only by ultrasound. Plum *J et al*³ found an exit site infection rate of 0.13 episodes per patient year when using clinical criteria only. The diagnosed infection rate almost trebles if the clinical criteria are combined with sonographic assessment.

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